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Technologies With Potential to Transform Business and Business Education: Artificial Intelligence

In September 2017, AACSB International's Innovation Committee convened to discuss the impact, opportunities, developments, and challenges around the topic of artificial intelligence (AI), particularly in regard to higher education and the industries business schools prepare graduates for. The below overview provides a glimpse into some of the major characteristics and developments within the AI space, as well as some general frameworks to inspire new ideas and discussion on how this growing technology impacts business education and its stakeholders.

This document is intended as a primer on a complex and ever-evolving topic and is not a scientific analysis of the phenomenon. A listing of references and resources is included to help guide further research and understanding on the topic. For questions or suggestions, please contact the AACSB Business Education Intelligence team at research@aacsb.edu.

What's Inside

What Do We Mean by Artificial Intelligence (AI)?

Although artificial intelligence (AI) may seem like a rather new phenomenon, the term has been in existence since 1955 when John McCarthy, a math professor at Dartmouth University, coined it.[1] Since then, the conversation around AI has been ever-evolving, as technical breakthroughs have continued to push boundaries regarding what AI can do across various industries. Since the 1950s scientists and researchers have made various predictions regarding AI's potential disruption. For example, in 1957 the economist Herbert Simon predicted that computers would beat humans at chess within 10 years (it took 40, when IBMS's Deep Blue Computer beat Russian chess master Garry Kasparov); and in 1967 the cognitive scientist Marvin Minsky said, "Within a generation the problem of creating 'artificial intelligence' will be substantially solved."[2] With such statements, it is easy to see why skepticism around AI's potential disruptive impact exists; however, the developments that we have experienced in the past decade, spanning sectors, have caused many experts to predict major changes as a result of AI in the near future.

First, it is helpful to define what AI is and what it entails, and to bring awareness to the various terms that are often associated with it. According to a recent PwC report, *Sizing the prize: What's the real value of AI for your business and how can you capitalise?*, AI is defined as "a collective term for computer systems that can sense their environment, think, learn and take action in response to what they're sensing and their objectives."[3] The report continues that AI works in four ways:

1. **Automated Intelligence:** Automation of manual/cognitive and routine/non-routine tasks.
2. **Assisted Intelligence:** Helping people to perform tasks faster and better.
3. **Augmented Intelligence:** Helping people to make better decisions.
4. **Autonomous Intelligence:** Automating decision-making processes without human intervention.[4]

[1] Nilsson, N. J. (2011, October). Professor John McCarthy. https://www-cs.stanford.edu/memoriam/professor-john-mccarthy

[2] Brynjolfsson, E., & McAfee, A. (2017, August 07). The Business of Artificial Intelligence. https://hbr.org/cover-story/2017/07/the-business-of-artificial-intelligence

[3] PwC AI. (2017). *Sizing the prize: What's the real value of AI for your business and how can you capitalise?* PwC. https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

[4] Ibid.

Thomas H. Davenport, an esteemed expert on AI, has written at length on the need to reframe the conversation around AI to focus on the feats that people might be able to achieve "if they had better thinking machines to assist them." An objective he aims to achieve through his work on AI is steering the focus away from the *threat of automation* and toward the *opportunity for augmentation*, which is explained in greater detail below.

In one post he shares the various terminology that is often used in conjunction or interchangeably with AI, including cognitive technology, cognitive computing, machine learning, machine intelligence, smart machines, robotics, robotic process automation, automation, and augmentation. These various terms may instill different perceptions of what AI is. For instance, "machine learning" may lead people to expect that all smart technologies can learn about their environment and improve their performance within it over time; "cognitive" could imply that society won't rely on human brains; and "automation" tends to instill fear in human workers that they will become obsolete.

Of the several terms used in these conversations, AI and machine learning remain dominant. According to Visual Capitalist, the distinguishing factor between the two is that AI represents a branch of computer science that aims to create intelligent machines that can mimic human decision-making processes, while machine learning represents machines that take data and "learn" for themselves, allowing them to improve at tasks with experience. Essentially, machine learning is a component within AI.

The conversation around automation vs. augmentation is an important one when it comes to how AI can impact industry sectors, employee demands and skill sets, and education and training. The difference between the two is that:

[A]utomation begins with a baseline of what people do in a given job and subtracts from that. It deploys computers to chip away at the tasks humans perform as soon as those tasks can be codified. Aiming for increased automation promises cost savings but limits us to thinking within the parameters of work that is being accomplished today. Augmentation, in contrast, means starting with what humans do today and figuring out how that work could be deepened rather than diminished by a greater use of machines.

[5] Davenport, T. H., & Kirby, J. (2015, June). Beyond Automation. https://hbr.org/2015/06/beyond-automation

[6] Davenport, T. H. (2017, May 23). What We Talk About When We Talk About AI. http://data-informed.com/what-we-talk-about-when-we-talk-about-ai/

[7] Desjardins, J. (2017, August 21). Visualizing the Massive $15.7 Trillion Impact of AI. http://www.visualcapitalist.com/economic-impact-artificial-intelligence-ai/

[8] Davenport, T. H., & Kirby, J. (2015, June). Beyond Automation. https://hbr.org/2015/06/beyond-automation

Recognition vs. Logic-based Reasoning Technology

Two important technological areas that stem from advancement in AI technology are recognition, including facial and voice recognition technologies, and logic-based reasoning technology (essentially technology that can "understand" cause and effect). Some regard these as the two main buckets of "intelligence" under which AI technology poses the greatest impact.

Of the two, recognition technology has made the greatest advancement over the past decades as seen with voice/sound recognition devices such as Siri through Apple or Alexa through Amazon, which work by encoding speech commands into digital formats that are compared against algorithms and previous input to decipher the meaning of the commands and provide desired results. Recent developments, such as those undertaken at iBUG at Imperial College,[9] include advancements in facial recognition technologies where machines are being trained to read faces by using sensors to track movements on the face, picking up on some nuances that are not even possible for the human eye to see. Recent research and developments suggest that AI is able to detect characteristics such as sexual orientation, political views, IQ, and other personality traits through facial recognition algorithms. Such developments raise various ethical questions on the application of these technologies and potential targeting of certain groups.[10]

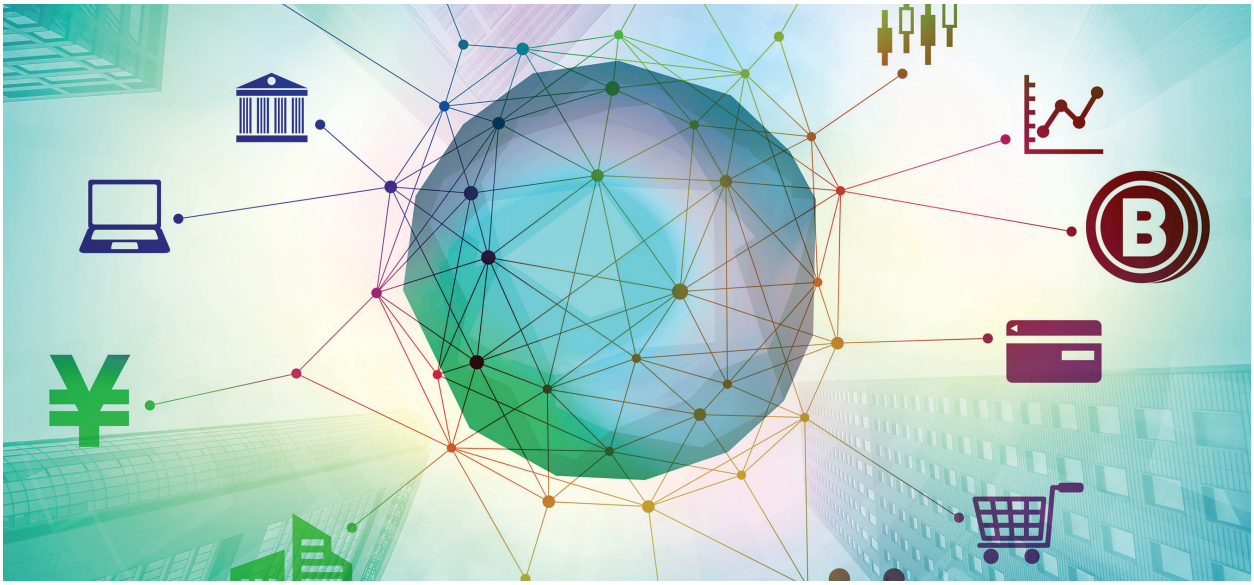
Logic-based reasoning technology has been slower to reach the same level of advancement as that of recognition technology, given that it is much more challenging to teach machines to encapsulate common-sense knowledge. In the 1950s and 1960s, when discussion around AI began to proliferate, researchers predicted that machines would be able to mimic the logic-based reasoning that human brains are thought to use. However, this ability has proven to be more challenging to achieve than initially predicted, as human brain functionality itself is not fully understood, much less how to re-create it in machines.[11]

[9] iBUG. https://ibug.doc.ic.ac.uk/home

[10] Levin, S. (2017, September 12). Face-reading AI Will Be Able to Detect Your Politics and IQ, Professor Says. https://www.theguardian.com/technology/2017/sep/12/artificial-intelligence-face-recognition-michal-kosinski

[11] Levy, S. (2010, December 27). The AI Revolution is On. https://www.wired.com/2010/12/ff_ai_essay_airevolution/

Which Sectors Are Expected to Be Disrupted? (first or the most)



It is inevitable that most, if not all, sectors or industries will be impacted by the proliferation of artificial intelligence in some way (and at some point) in the future. However, many researchers and experts have identified several industries that may feel the effects sooner or to a greater degree. According to an article from the *McKinsey Quarterly*, the industries and jobs that require a significant amount of knowledge work (e.g., expertise in decision-making, planning, or creative work), as well as the management and development of people, will be the hardest to automate and replace with AI. The authors of the article identify the financial sector as one that "has the technical potential to automate activities taking up 43 percent of its workers' time." More specifically, although much of finance relies on professional expertise of stock traders and investment bankers, "about 50 percent of the overall time of the workforce in finance and insurance is devoted to collecting and processing data, where the technical potential for automation is high." Mortgage brokers are estimated at spending as much as 90 percent of their time processing applications; introducing more sophisticated verification processes for documents and credit applications could reduce that number to just more than 60 percent.[12]

[12] Chui, M., Manyika, J., & Miremadi, M. (2016, July). Where machines could replace humans—and where they can't (yet). http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet

An opportunity here is that such advancements would allow for advisers to focus more of their time on advising clients rather than on routine processing, in turn producing greater value for the customer and mortgage institution.[13] Davenport reflects on a conversation he had with a financial adviser who said, "Our advice to clients isn't fully automated yet, but it's feeling more and more robotic. My comments to clients are increasingly supposed to follow a script, and we are strongly encouraged to move clients into the use of these online tools." However, the adviser continued, "Reading scripts is obviously something a computer can do; convincing a client to invest more money requires some more skills. I'm already often more of a psychiatrist than a stockbroker."[14]

According to McKinsey, the technical feasibility of automation is lowest in education (at least for now). Although digital technology is transforming the field, as can be seen from the various online delivery tools becoming available and introduced, the essence of teaching encompasses deep expertise and complex interactions with other people. Actions reliant on those two categories account for about half of the activities in the education sector. About 27 percent of the activities within the education industry—primarily those that happen outside the classroom and account for various support services (including administrative, maintenance, etc.)—have greater potential to be automated through new technologies. For example, the automation of certain data-collection and processing activities may help to reduce the growth of the administrative expenses of education and to lower its cost without affecting its quality.[15] This overview will later discuss some of the major AI advancements increasingly occurring within higher education and the implications they may have on faculty, students, and institutions and their stakeholders.

[13] Ibid.

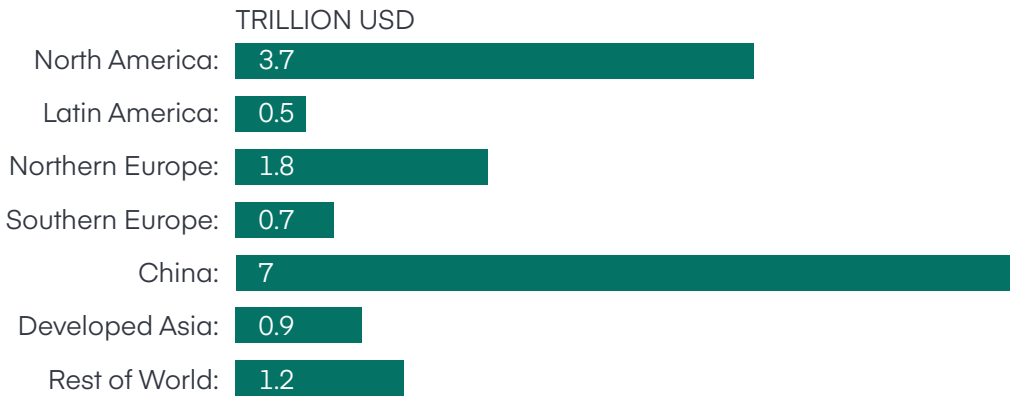
[14] Davenport, T. H., & Kirby, J. (2015, June). Beyond Automation. https://hbr.org/2015/06/beyond-automation

[15] Chui, M., Manyika, J., & Miremadi, M. (2016, July). Where machines could replace humans—and where they can't (yet). http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet

Potential Global Economic Impacts

According to PwC research, AI can significantly impact contributions to the global economy, with a potential of 15.7 trillion USD by 2030—a 14 percent increase from today's GDP. From a regional perspective, these projections for 2030 show the following economic gains:

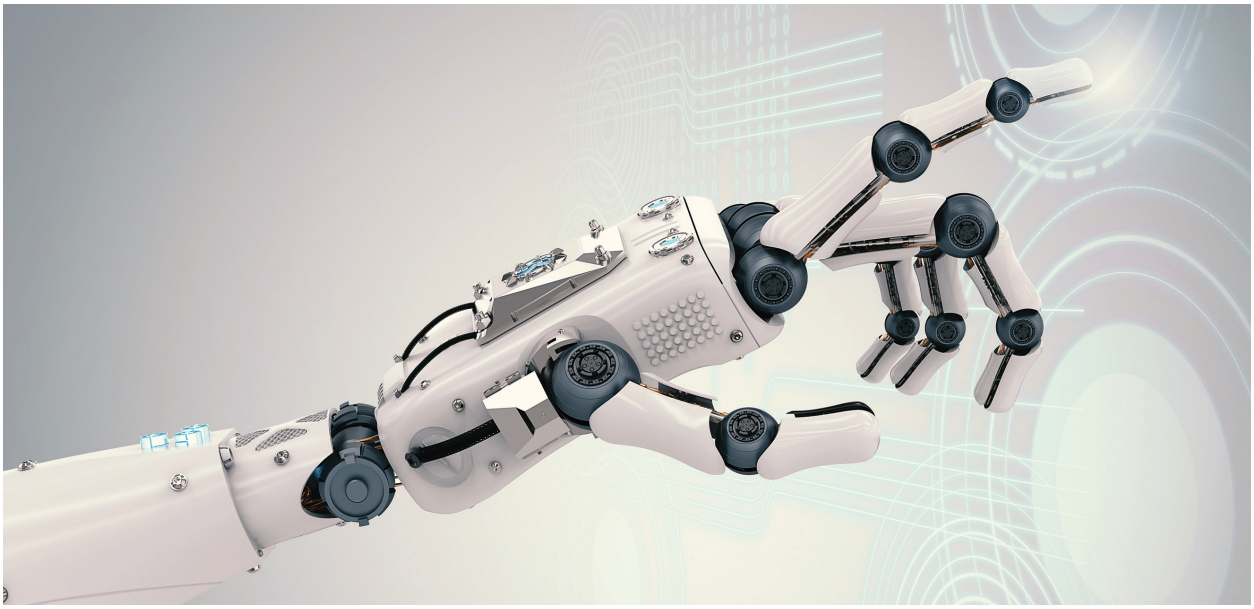
Projected Global Economic Effects of AI by 2030



Further, the biggest absolute sector gains are expected to be seen within retail, financial services, and health care.[16]

[16] PwC AI. (2017). *Sizing the prize: What's the real value of AI for your business and how can you capitalise?* PwC. https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

Thriving With Artificial Intelligence



Which type of skill sets and what qualities an employee will need to thrive in a future where AI is more prevalent are questions increasingly tackled by businesses, educators, and current employees. A general consensus seems to be that a successful employee will need to be able to combine traditional soft skills (such as communication, collaboration, persuasion, critical thinking, etc.) with hard, technical skills, including some degree of technological/software competence and literacy. Len Morrison, head of undergraduate career services at Bentley University, summarized that intellectual curiosity and being "authentic about wanting to learn, which means taking on 'stretch' assignments and getting as many experiences as you can" ought to comprise priorities among graduating students and current employees.[17] A study conducted by Bentley University using labor market data firm Burning Glass concluded the following:

This evolution reflects a growing movement in higher education, where more and more schools are finding creative ways to truly integrate liberal arts strengths with professional technical skills. It is the way we need to teach and work—by helping to develop the ability to view opportunities, challenges, and problems through multiple perspectives, whether it is a student or an employee. It is exactly the type of change and innovation necessary to drive our economy.[18]

[17] Fisher, A. (2016, March 11). Why 2016 Is the Year of Hybrid Job Skills. http://fortune.com/2016/03/11/hybrid-job-skills/

[18] Bentley University. (2016, February 16). The Time for the Hybrid Job is Now. http://www.bentley.edu/prepared/time-for-hybrid-job

As mentioned earlier, Davenport continuously comes back to the notion of instilling a change of mindset in companies and employees in embracing augmentation (vs. automation) in regard to AI. Through this shift, knowledge workers will come to see smart machines as partners and collaborators in creative problem-solving. Davenport goes on to outline "Five Paths for Employability" in working with AI:

1. **Stepping Up:** moving a level above the machines and making high-level decisions about augmentation
2. **Stepping Aside:** letting the machines in your field take over and choosing to pursue a job that computers are not good at, such as selling or motivating
3. **Stepping In:** monitoring and improving the computer's automated decisions
4. **Stepping Narrowly:** finding a specialty area in your profession that wouldn't be economical to automate
5. **Stepping Forward:** becoming involved in creating the very technology that supports intelligent decisions[19]

Davenport emphasizes that the greater opportunity for business success exists through augmentation. He points out the Tesla fatal collision in 2016 as an example of the potential failures of an automation-oriented solution, which essentially entailed overreliance on vehicle automation versus working alongside the new technology with a certain level of human attention and interaction. Further, he predicts that if companies choose to embrace augmentation-oriented solutions, "there's going to be a lot of jobs for people working alongside smart machines…" and further, this could "…lead to pretty dramatic productivity gains which finance things like re-education programs and redeployment programs."[22] Returning to the example of self-driving cars, this would mean new demands on human skill sets and types of jobs. For autonomous cars to recognize road signs and pedestrians, algorithms must be trained by feeding them video showing both. That footage needs to be manually "tagged," meaning that road signs and pedestrians have to be marked as such, which already keeps thousands busy. Once an algorithm is in place, humans must check whether it is effective and provide feedback to improve it. [21]

[19] Davenport, T. H., & Kirby, J. (2015, June). Beyond Automation. https://hbr.org/2015/06/beyond-automation

[20] Straight Talk. (2016, September 13). Artificial Intelligence: How to Work with Very Smart Machines. https://straighttalk.hcltech.com/artificial-intelligence-how-work-very-smart-machines

[21] The Economist. (2017, August 26). Artificial intelligence will create new kinds of work. https://www.economist.com/news/business/21727093-humans-will-supply-digital-services-complement-ai-artificial-intelligence-will-create-new

A challenge that companies may face as they choose to further explore AI technology and inclusion of smart machines in their work systems is understanding which technology (as there are many options already available) is most appropriate to their specific application needs and organizational goals, and in turn designing the appropriate division of labor between humans and computers. According to Davenport:

> *Successful enterprises will be augmentation-oriented from the beginning and will develop a strategy for employees to take advantage of augmentation. It's going to take a while for humans to pick which of these five roles they're interested in so employers may want to give them some time to think about that and learn the necessary skills. When employers invest in augmentation, they create a work environment in which knowledge workers are empowered to do more, not asked to do less—and as a result more value accrue to them as well as to the enterprise's customers, partners, and other stakeholders.*[22]

[22] Davenport, T. H. (2016, September 13). Artificial Intelligence: How to Work with Very Smart Machines. https://straight-talk.hcltech.com/artificial-intelligence-how-work-very-smart-machines

AI in Higher Education

As a result of the conversation around AI's potential impacts on the workforce, industry sectors, and employee skill sets, naturally the subject has become an area of focus across higher education. Questions about whether jobs will be displaced by AI have increased with recent developments such as Todai Robot in Japan, which passed the entrance exam (which includes a multiple choice and essay section spanning seven subject areas), of the University of Tokyo, a leading university in the country. Todai Robot was able to do so through search and optimization technology, which actually resulted in a better essay score than the majority of students. The advantage that humans have over AI machines such as Todai Robot is the ability to read and understand material, but according to Noriko Arai, professor at the National Institute of Informatics in Tokyo, Japan, this is a skill that is increasingly dwindling among students, regardless of the amounts of learning materials accessible to them. As a result, some level of concern is warranted on what AI development can mean for the types of careers we are preparing students for.[23]

In regard to AI's potential impact on higher education and its delivery, the *NMC Horizon Report: 2017 Higher Education Edition*, produced by New Media Consortium (NMC), states that AI has the "potential to enhance online learning, adaptive learning software, and research processes in ways that more intuitively respond to and engage with students."[24] The term we hear most commonly around AI application within higher education is adaptive learning, which Samantha Adams Baker, senior director of publications and communications at NMC, generally characterizes as leveraging "basic AI algorithms to personalize learning and deliver content that students need." Through the process, educators obtain data that informs individual student and class needs, as the students learn throughout the educational experience.[25]

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[23] Arai, N. (n.d.). Transcript of "Can a robot pass a university entrance exam?" https://www.ted.com/talks/noriko_arai_can_a_robot_pass_a_university_entrance_exam/transcript

[24] Elmes, J. (2017, February 17). Artificial intelligence 'to revolutionise higher education.' https://www.timeshighereducation.com/news/artificial-intelligence-revolutionise-higher-education#survey-answer

[25] Ibid.

The Open Learning Initiative (OLI) at Carnegie Melon University was developed through support of institutions such as the Bill & Melinda Gates Foundation and the Lumina Foundation, among others, to combine "open, high quality courses, continuous feedback, and research to improve learning and transform higher education," and represents one example of a major AI development within higher education.[26] The initiative was largely built around the notion of one of its former professors and Nobel Laureate, Herbert Simon, who said, "Improvement in post-secondary education will require converting teaching from a solo sport to a community based research activity."[27]

OLI's online courses are open to anyone who wants to teach or learn, and the program aims to allow for continuous evaluation, improvement and growth of courses and course materials, and contribution to research around open educational resources.

Adaptive learning initiatives like OLI generally highlight very similar benefits as well as potential disruptions that higher education stakeholders may face:

- **Students** are presented with immediate feedback, helping them assess their own learning and study, along with clear learning objectives. Further, as people learn in different ways and at different paces, adaptive learning environments can allow for a student to follow an individualized pace.
- **Faculty** are presented with data based on their students' learning, achievement, and progress over time, which helps in determining whether a student needs further help with a particular concept or subject. Adaptive learning tools allow teachers to place students on individual learning pathways, enabling students to set their own pace until they have completed that path. While dependent on at least some engagement with a live faculty member, adaptive learning disrupts the traditional classroom model with automated and more scalable formats that are less dependent on in-person instruction. This change may actually strengthen instruction as faculty take on a more supporting, coaching role, with less time devoted to delivery of content, which students may or may not already have mastered, and more time focused on one-to-one student engagement and guidance through a self-paced curriculum. In this way, technology does not necessarily replicate face-to-face learning (as with online learning), but rather drives learning from start to finish by incorporating the right mix of online and face-to-face instruction where suitable.[28]

[26] Open Learning Initiative at Carnegie Melon University. https://oli.cmu.edu/

[27] Ibid.

[28] Fleming, B. (2014, April 2). Adaptive Learning Technology: What it is, Why it matters. http://www.eduventures.com/2014/04/adaptive-learning-technology-matters/

- **Institutions themselves** may see potential opportunity to incorporate more AI technologies and adaptive learning in order to cut costs, grant greater access, and improve quality by substituting technology for labor and conversely allowing best-in-class pedagogy and analytics to improve the quality of education. The data collected can allow for the creation of new partnerships that otherwise may not have been possible. However, as is discussed later, certain challenges and obstacles exist in effectively introducing such technologies.
- **Higher education from the perspective of an industry/consumer need** may also change as AI technologies such as adaptive learning gain more steam. With the demand for new and additional skill sets as described earlier, people will likely no longer consider higher education as a one-time experience, but rather engage in various platforms of lifelong learning. AACSB's *Collective Vision* report highlights this development through its opportunity for business schools to become Hubs of Lifelong Learning—connecting individuals to business school expertise and experiences to create opportunities across career life cycles.[29] Joseph E. Aoun, president of Northeastern University, states in a 2016 *Washington Post* article, "Colleges and universities need to be doing more to move beyond the array of two-year, four-year, and graduate degrees that most offer, and toward a more customizable system that enables learners to access the learning they need when they need it. This will be critical as more people seek to return to higher education repeatedly during their careers, compelled by the imperative to stay ahead of relentless technological change."[30]
- **Higher education research** is already seeing glimpses of AI's impact within some disciplines. For example, Smart Flower Recognition System is a partnership between Microsoft Research Asia and the Chinese Academy of Sciences that was developed to help botanists in China quickly identify plants with photos taken by smartphones. Through neural networking, algorithms automatically filter out low-quality image submissions and identify the flowers in the photo database with over 90 percent accuracy. The implications of this kind of project for student and faculty research can be compelling, as search queries no longer have to be based on text. As outlined in

[29] AACSB International (2016). *A Collective Vision for Business Education*. http://www.aacsb.edu/-/media/management-education/docs/collective-vision-for-business-education.ashx

[30] Aoun, J. E. (2016, October 27). Opinion | Higher education for the AI age: Let's think about it before the machines do it for us. https://www.washingtonpost.com/news/grade-point/wp/2016/10/27/higher-education-for-the-ai-age-lets-think-about-it-before-the-machines-do-it-for-us/

> the *NMC Horizon Report: 2017 Higher Education Edition*, "to scale the affordances of AI over the next four to five years, higher education can start with open-source codes and open software libraries for numerical computation, as provided by OpenAI and Google's TensorFlow."[31]

The concept of "push research" has become a popular topic among the law profession but can be applied across various disciplines. Through push research, "your computer 'understands' your context, and based on that understanding, proactively sends you the information you need to see, sometimes before you even knew to ask the question."[32] For knowledge workers, this technology can help save significant amounts of time in seeking out new information and in improving research quality by finding information that may have otherwise been missed.

Although proponents of greater incorporation of adaptive learning, machine learning, and other AI innovations into higher education are quick to tout the various benefits, there are a number of challenges and barriers that many within the higher education space also point to. For example, a survey conducted by Chapman Alliance shows that developing one hour of eLearning content can take anywhere between 49 to 125 hours, in comparison to the 22 to 82 hours it takes to create content for instructor-led training.[33] Factors like this, as well as staff training, expensive software and equipment, etc., can impact the upfront investment for adaptive technology that may still be beyond what most institutions can afford, especially given that long-term payoff remains largely unproven.

Another challenge for consideration involves responsibility. In traditional training/learning environments, the trainer or educator is responsible for the information being relayed to learners and assumes the responsibility to ensure that it is accurate. However, with AI, the creators of the algorithms are not the creators of the content their algorithms produce. This may present a problem if something goes wrong, as machines cannot be held accountable in the same way that humans can. Mustafa Suleyman, Google's Deep Mind CEO, addressed this issue in a discussion at the Disrupt London tech conference, stating the responsibility designers and technologists must take when building such systems. It is up to the people managing the AI systems to ensure that the data being processed is fair and accurate—similar to a teacher's responsibility to teach with accurate material.[34]

[31] Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., and Ananthanarayanan, V. (2017). *NMC Horizon Report: 2017 Higher Education Edition*. Austin, Texas: The New Media Consortium. http://cdn.nmc.org/media/2017-nmc-horizon-report-he-EN.pdf

[32] Heller, J. (2017, November 15). Push Research: How AI is Fundamentally Changing the Way We Research the Law. https://abovethelaw.com/2017/11/push-research-how-ai-is-fundamentally-changing-the-way-we-research-the-law/

[33] Hauptfleisch, K. (2016, December 28). This Is How Artificial Intelligence Will Shape eLearning For Good. https://elearningindustry.com/artificial-intelligence-will-shape-elearning

[34] Ibid.

Further Viewing/Reading on AI

The following list of references includes materials captured in the above overview, as well as additional materials for deeper exploration into AI trends and developments.

[View]

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